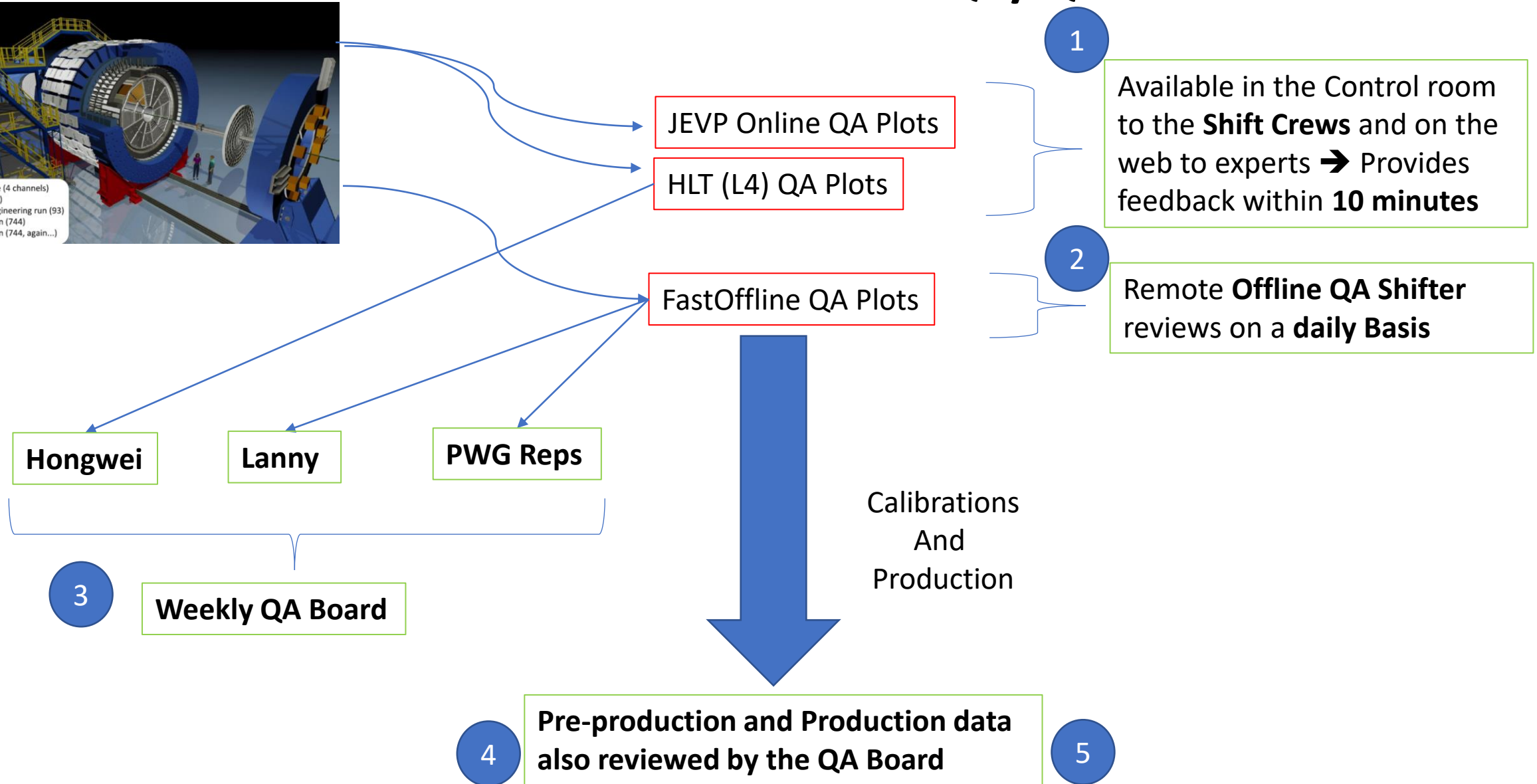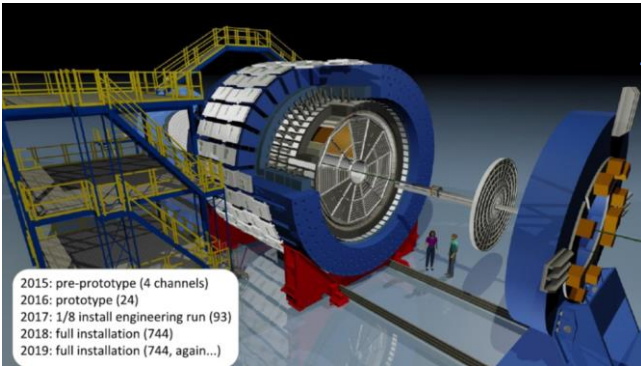# TPC Calibrations Review:
QA,QC (BES-II)

Daniel Cebra
University of California, Davis

- Recap of resources
- How are working groups involved in this
- Feedback, requirements to calibrations

* Note: I do not believe that the PWGs have provided requirements to the calibrations previously, so please consider the requirements that I present to be a work in progress.

General Scheme of BES-II QA/QC

2015: pre-prototype (4 channels)
2016: prototype (24)
2017: 1/8 install engineering run (93)
2018: full installation (744)
2019: full installation (744, again...)

JEVP Online QA Plots

HLT (L4) QA Plots

1 Available in the Control room to the **Shift Crews** and on the web to experts ➜ Provides feedback within **10 minutes**

FastOffline QA Plots

2 Remote **Offline QA Shifter** reviews on a **daily Basis**

Hongwei

Lanny

PWG Reps

3 **Weekly QA Board**

Calibrations And Production

**4** **Pre-production and Production data also reviewed by the QA Board** **5**

Why so many levels of QA/QC?

- Low energy means poorly focused beams, which means LOTS of background triggers
  - Raw trigger counts are not a good count of whether we can achieve our physics goals
  - HLTgood is our "official" good event count

- BES-II is looking for changes from energy to energy, these need to be real and not artifacts, so the data better be good

- We assume that we will not run these energies again, so we understand that we have to get it right

- It is important to involve the working groups because much of what changes run to run does not effect physics

Resources:

- **Online QA plots** ➔ Reviewed primarily by the **Shift Crew,** but also by the Shift Leader, Detector Operator, Period coordinator, Run Coordinator, and expects as needed ➔ **First Line of defense for Detector QA**
  - ➔ Only Detector performance plots
- HLT (L4) ➔ Reviewed primarily by the **Shift Crew**, but also by the Shift Leader, Detector Operator, Period coordinator, Run Coordinator, and expects as needed ➔ **First line of Defense for RHIC performance QA**
  - ➔ A selection of global event variables
- **Fast Offline** ➔ Reviewed daily by Offline QA shifter, Summarized weekly by Lanny Ray at the weekly QA Board meetings, and reviewed weekly by the PWG representative of LFSUPC, BulkCorr, HeavyFlavor, and Jet Corr; Also available for pre-preliminary data analysis to the analysis teams
  - ➔ Typically 1% of the total data set, calibrations are updated when available
- **ExressStream data** ➔ Reviewed weekly by Hongwei at the Weekly QA board meetings; Also available for pre-preliminary analysis to the analysis teams
  - ➔ Sample range from 5-70% of data set, calibrations are updated when available
- **Pre-production data sets** ➔ Reviewed by the PWG representatives at the weekly QA Board
  - ➔ Typically 1% of data set, fully calibrated
- **Production data** ➔ Studied by the PWG representative at the weekly QA board meeting to generate good runs lists.
  - ➔ Full data set, fully calibrated

Examples of JEVP Online TPC QA plots: Mostly useful for spotting tripped detector components
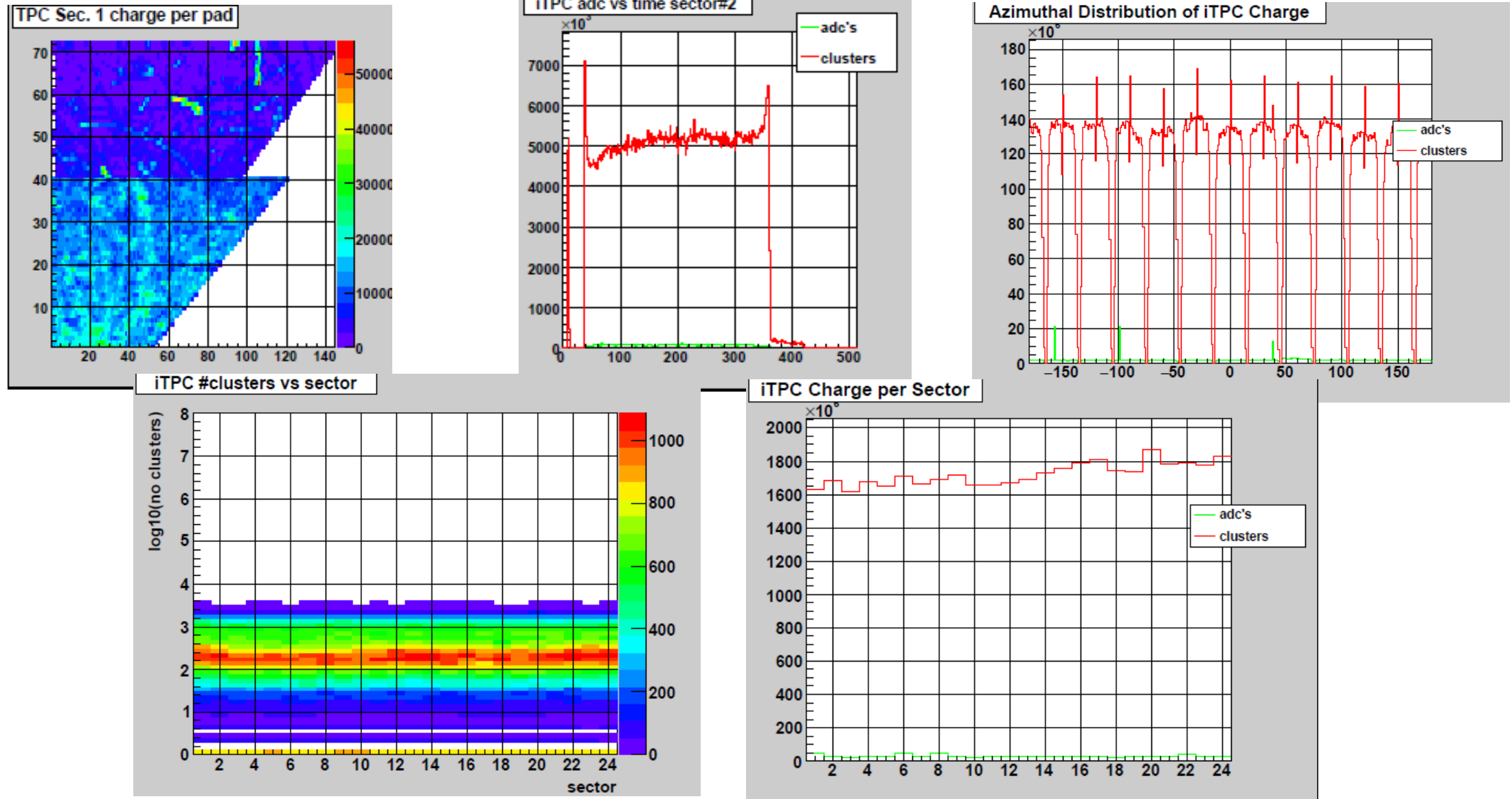
Examples of HLT Online QA plots: Extremely useful for tracking collider performance
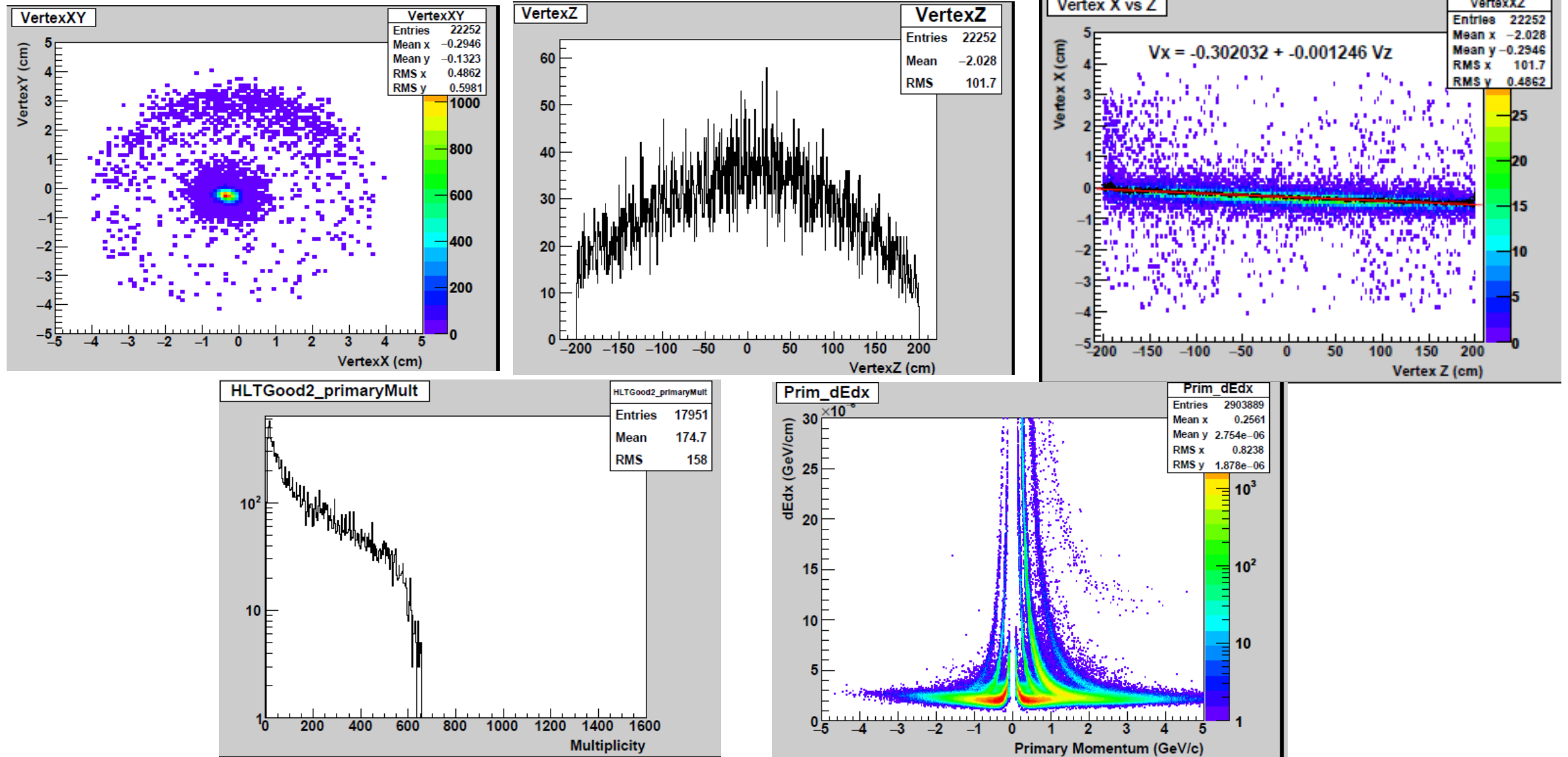
Involvement by the Physics Working groups

QA Board: (Abreviated List**)**

Chair – Frank Guerts

Meets weekly during the run, and as needed when production data sets become available

Overall Performance – DAC

HLT – Hongwei

General Overview Presentations

FastOffline – Lanny ray

LFSUPC – **Chenliang Jin**

BulkCorr – **Ashish Pandav**

Detailed run-by-run analysis including relevant physics observables

JetCorr – **Tong Liu**

HeavyFlavor – **Yingjie Zhou**

Detector Experts

The PWGs will ultimately determine good run lists based on rejecting run where observables fall outside of 3 sigma bounds

LFSUPC uses 26 observables

BulkCorr uses 21 observables

Anticipate rejecting 5% of runs

JettCorr uses 20 observables

Heavy Flavor uses 20 observables

Typical things that cause runs rejection:
- RDOs taken out of runs
- TOF loses a section
- BEMC loses PMT boxes
- eTOF data missing (special)
- Poor beam quality

Sample LFSUPC QA Plots

AUAU_7P7GEV QA(GTRACK)

This feature is due to a calibrations database update
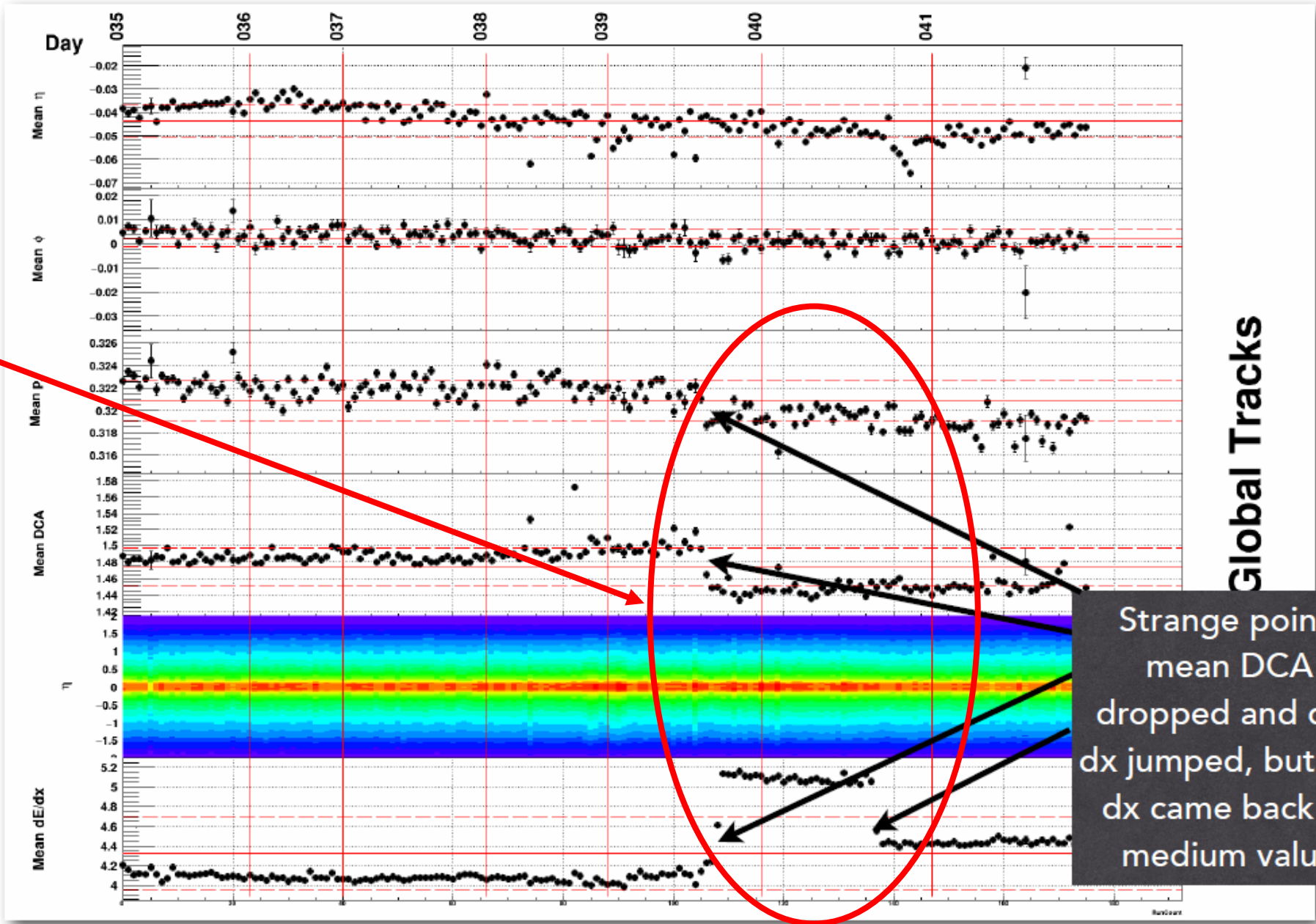
Strange point, mean DCA dropped and dE/dx jumped, but dE/dx came back to medium value
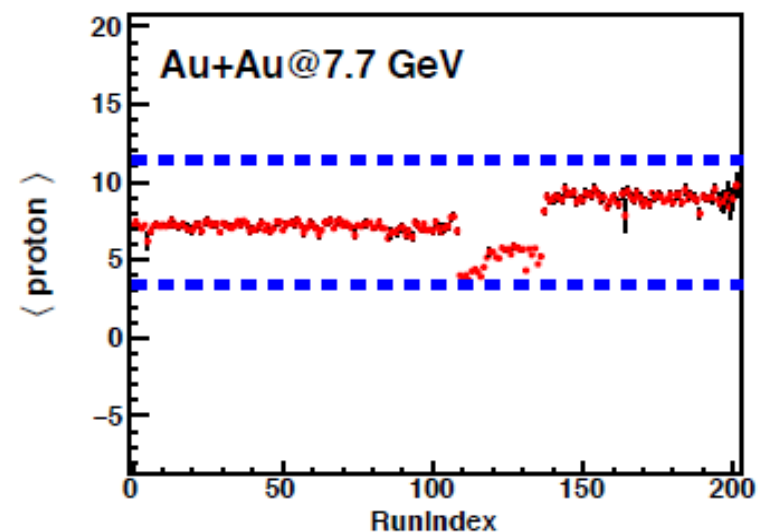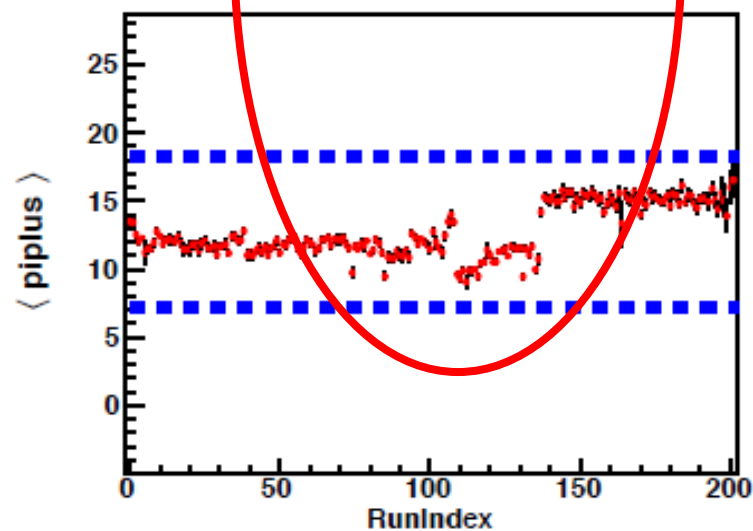
Daniel Cebra 2/16/2021

AUAU_7P7GEV QA(PTRACK)

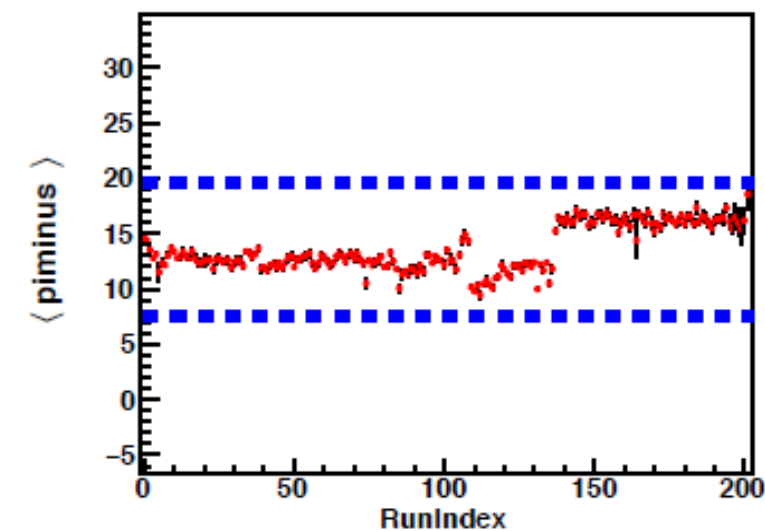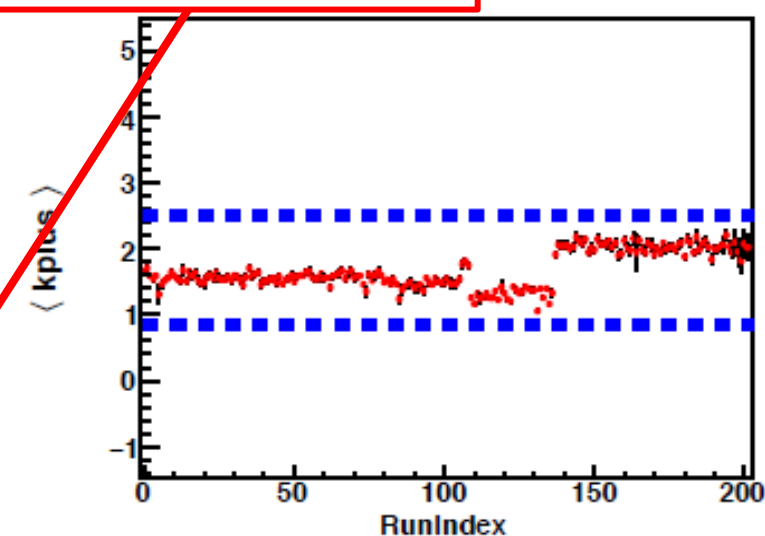Calibrations database update does not have a big effect on the pions (LFSUPC) (3 nσ_π)

bTOF is calibrated in day041
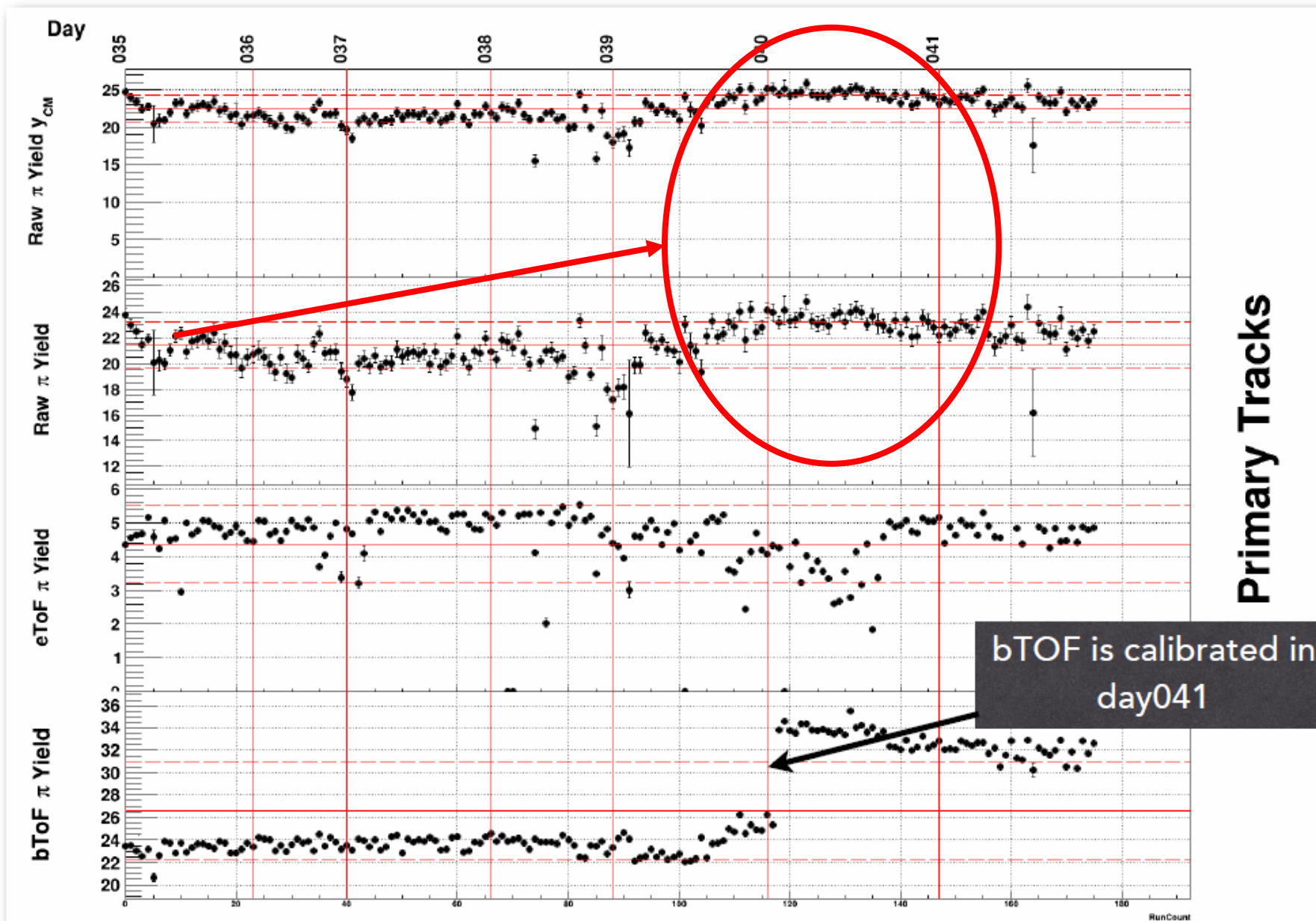
Sample BulkCorr QA Plots
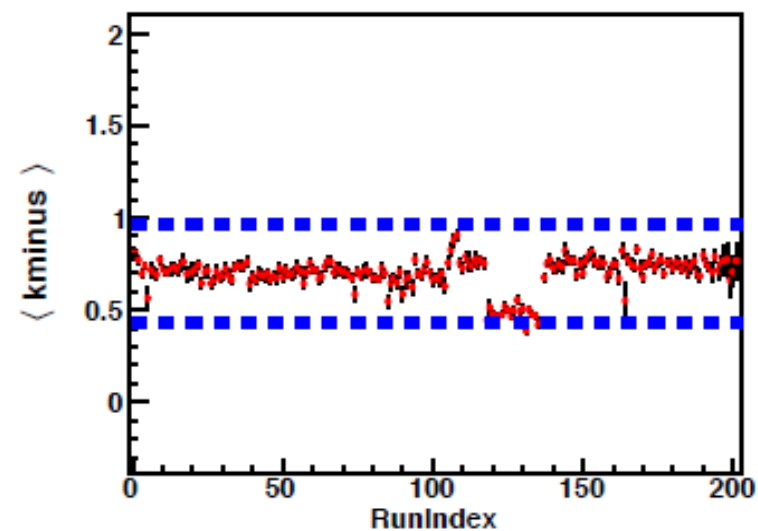
Run by run QA- analysis
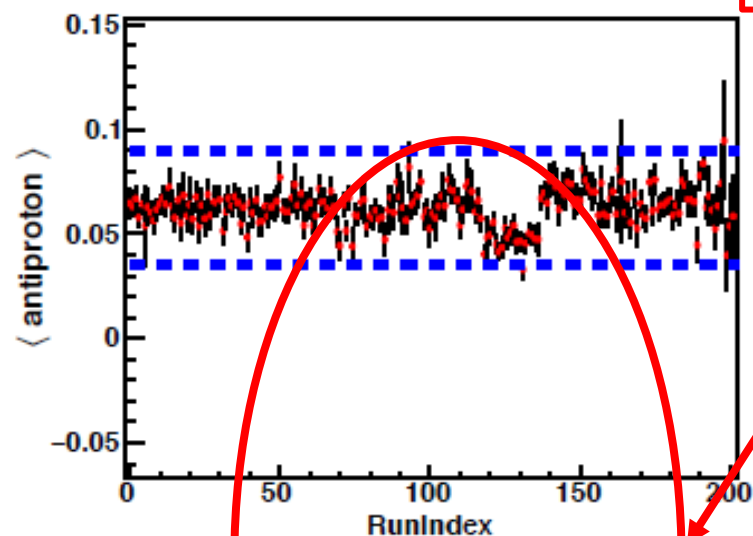
BulkCorr sees an effect on pions

Au+Au@7.7 GeV

Sample Heavy Flavor QA Plots

Run by run QA

Calibrations database update affects nhits (1 hit)

Sample JetCorr QA Plots
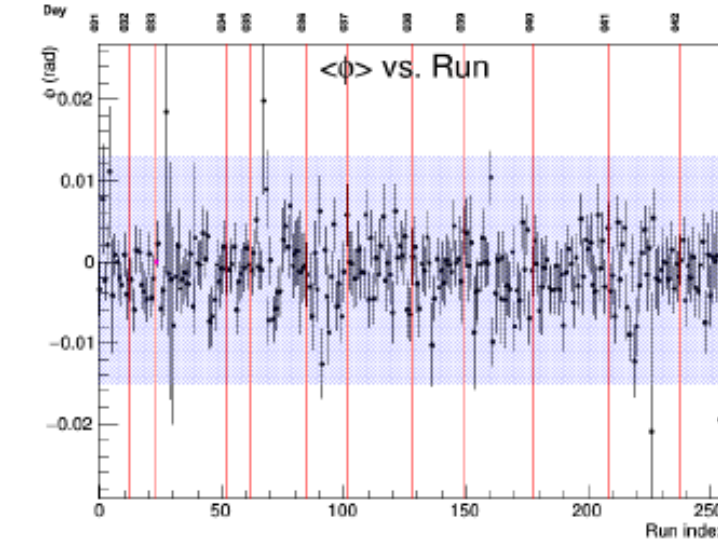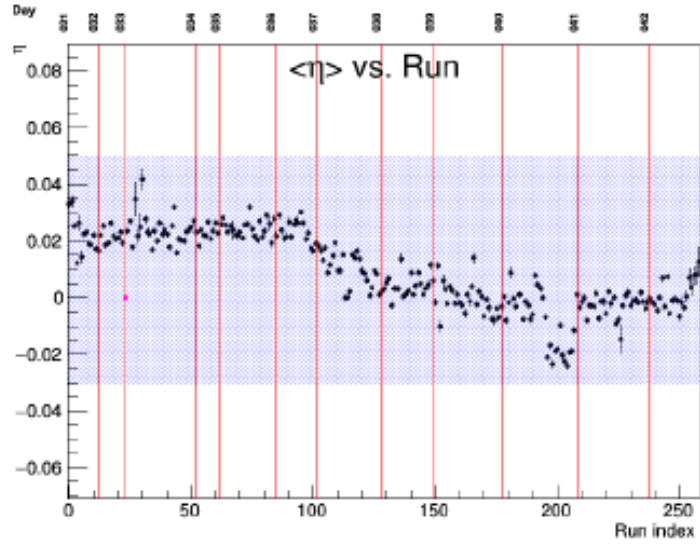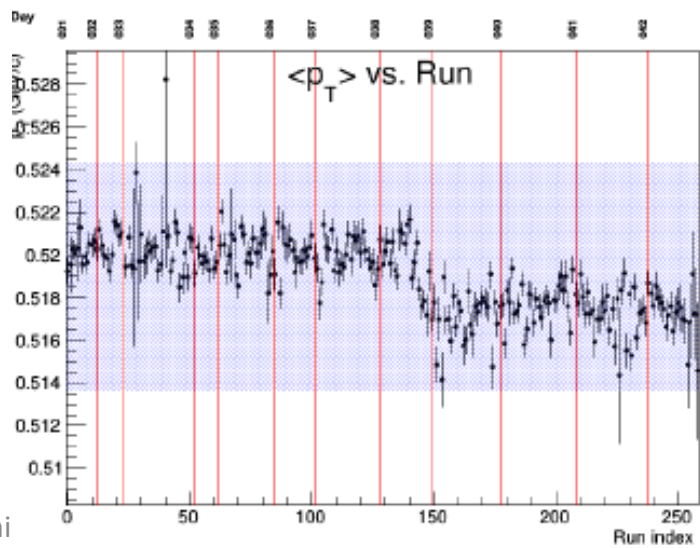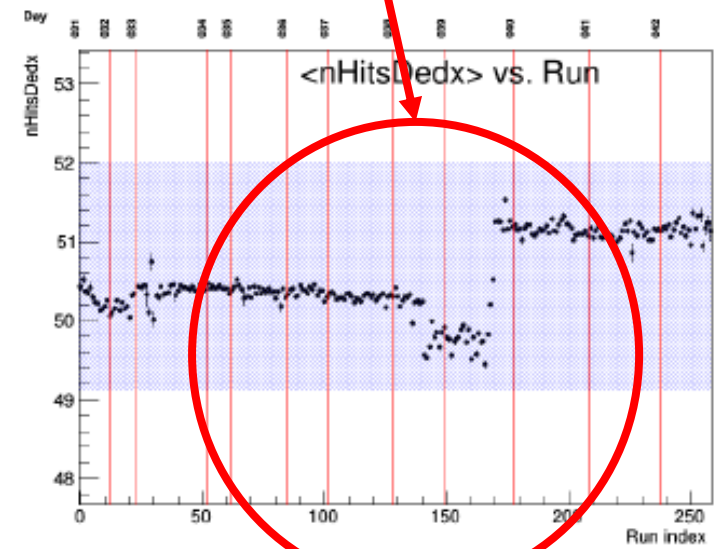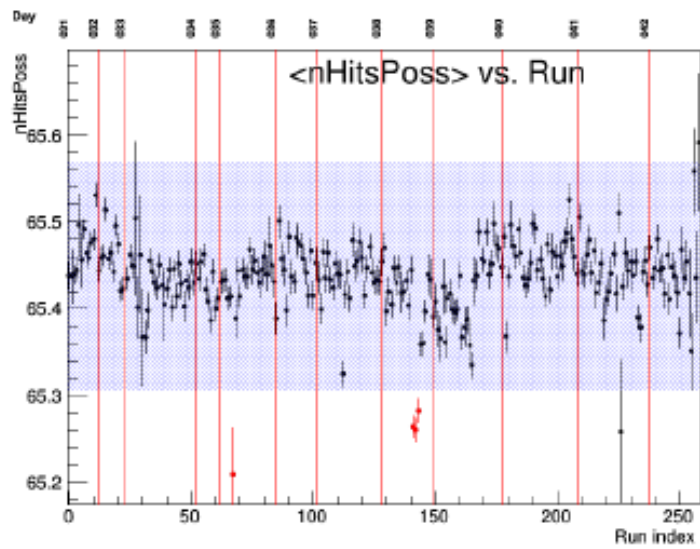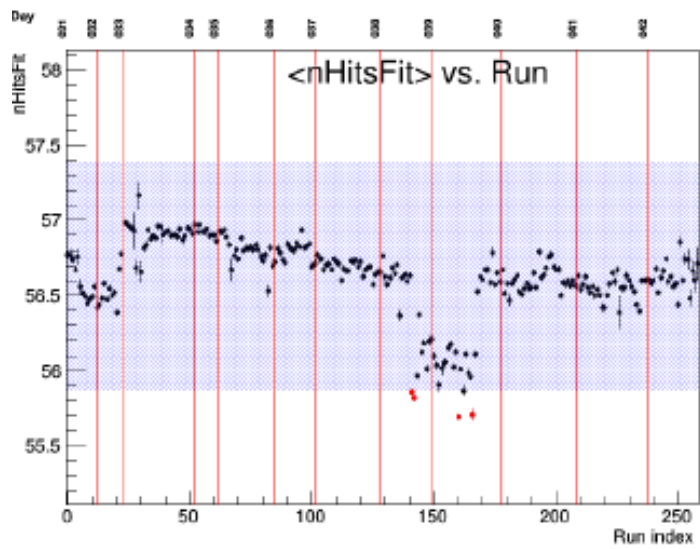
Run-by-run nhit

Calibrations database update effects nhits by 0.5 hits

Fraction of tracks with nhit > 15

Tracks with nhitratio > 0.52

9
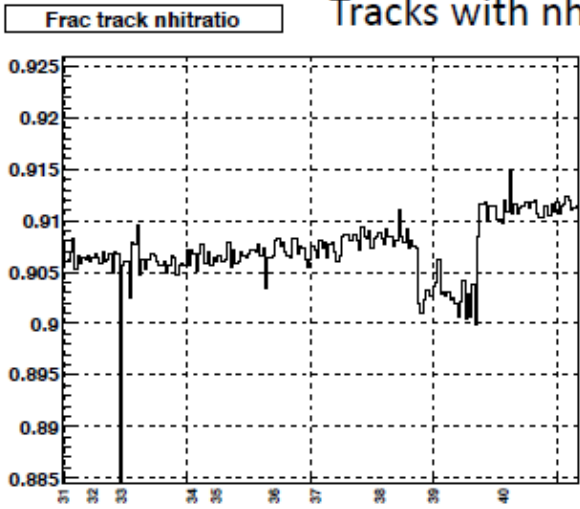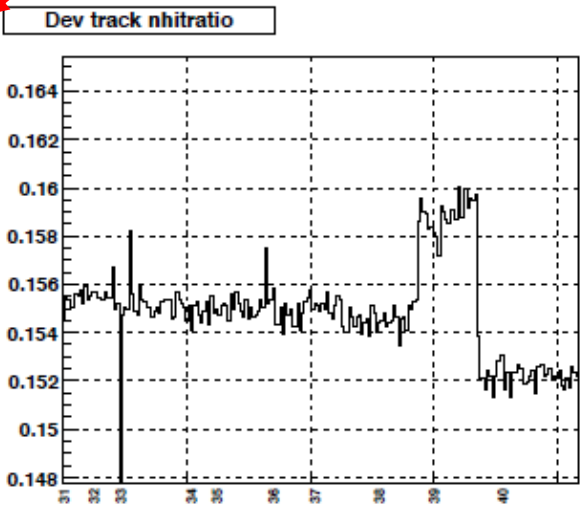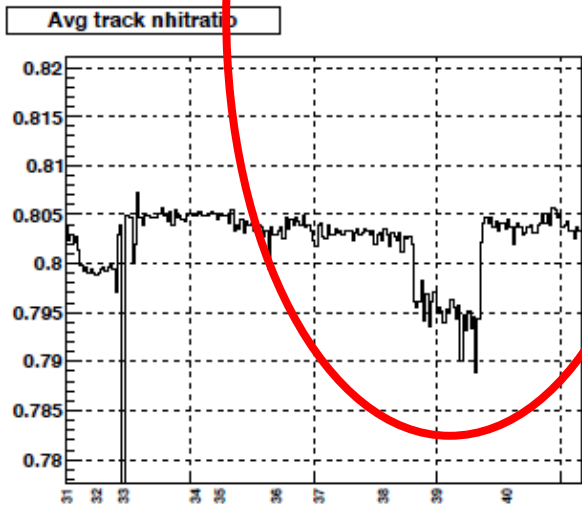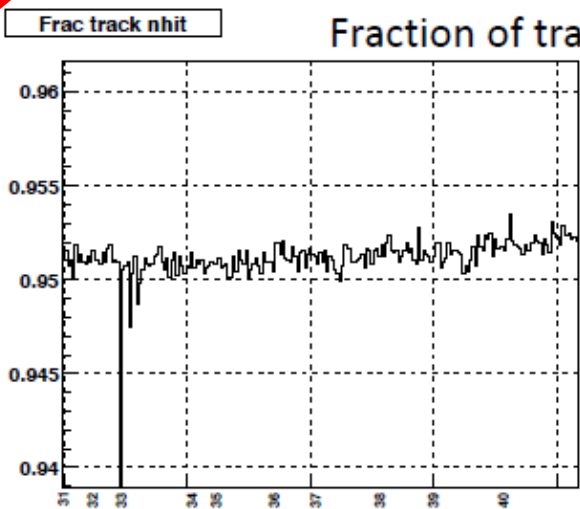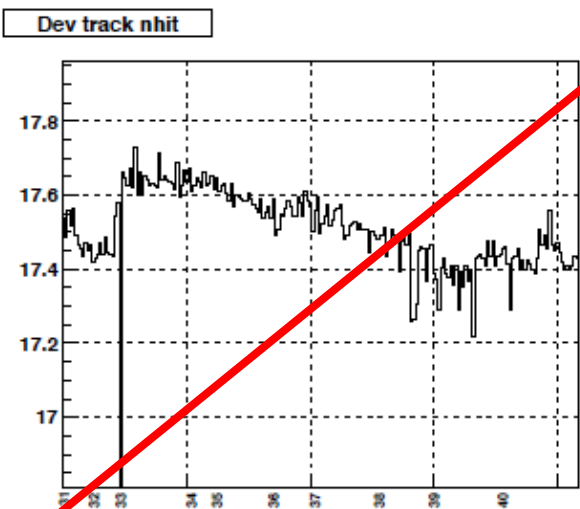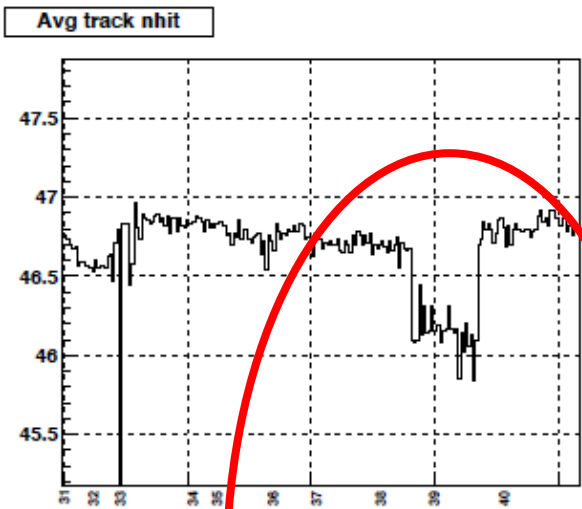
Plans for run-by-run good run lists:

- All working groups should use the same good run list (unless a particular analysis has specific requirements)

- Expect about 5% of runs to be rejected by run-by-run QA

- We will develop an agreed upon set of observables

- Many working groups use observables which depend on beam parameters (such as <Vz>), these need to be eliminated

- Rejected runs will be correlated to issues identified in the shift logs or other known causes (often very short runs are rejected)

- Good-run list gets incorporated into StRefMultCorr so all analyzers use the same list

Feedback: Requirements to Calibrations

Typical good track cuts are DCA < 3 cm (some analyses use 1 cm, nhits > 15 (some add frac > 51%), and PID selection cuts typically set at $|n\sigma| < 3$ ➔ These set the requirements for calibrations

Of course, calibration issues are systematic errors

Drift Velocity ➔ breaks tracks at membrane ➔ affects nhits

Track selection and acceptance

T0 ➔ Breaks tracks at the membrane ➔ affects nhits

dE/dx ➔ affects PID

Alignment ➔ affects DCA

Track selection and momentum

Space Charge ➔ affects DCA
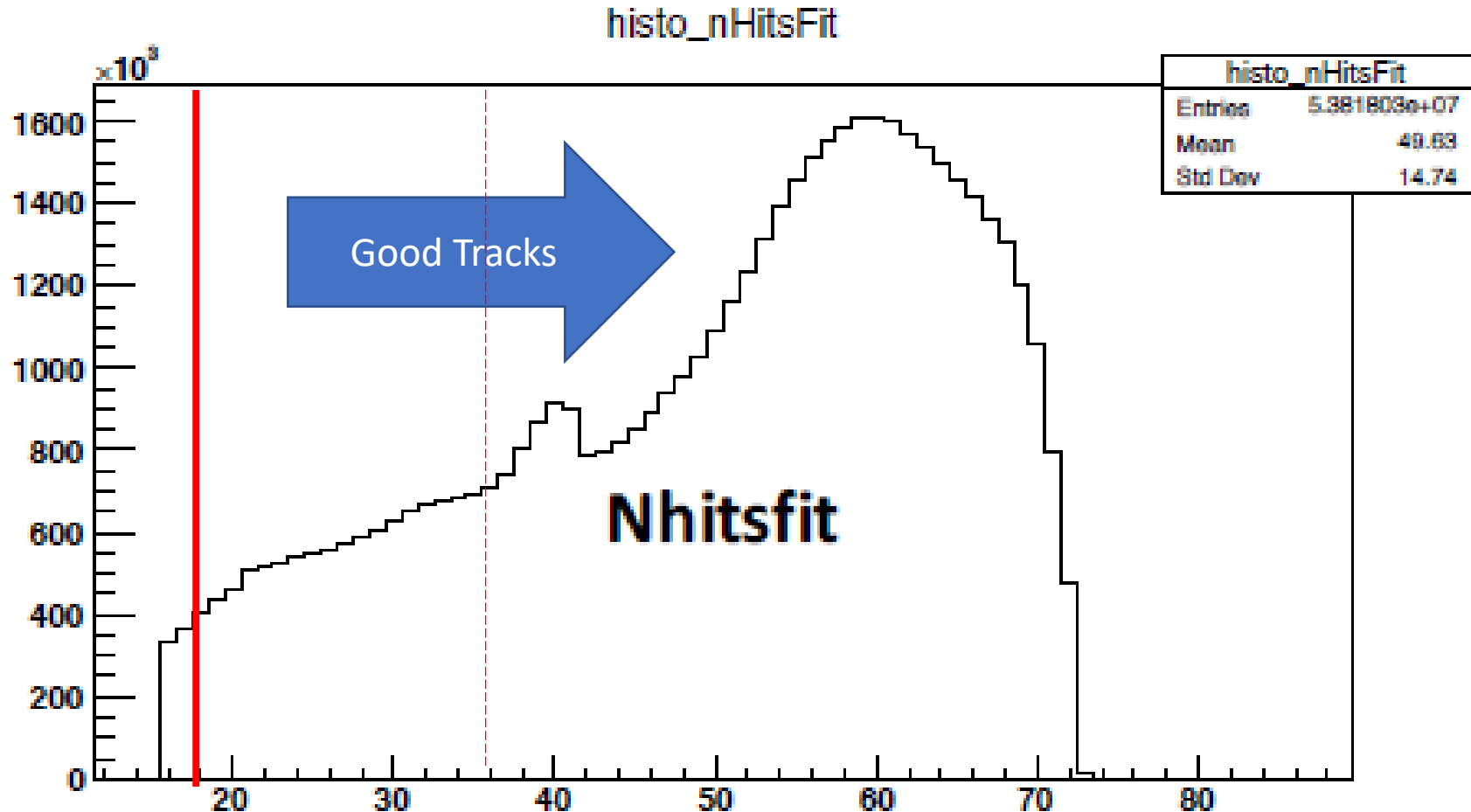
Drift Velocity and T0 Calibrations:

Tracks will only be lost if broken at the half way point, so you get 36 hits on each half

PWGs are setting there good run cut bands at changes in Nhits < 0.5 to 0.8
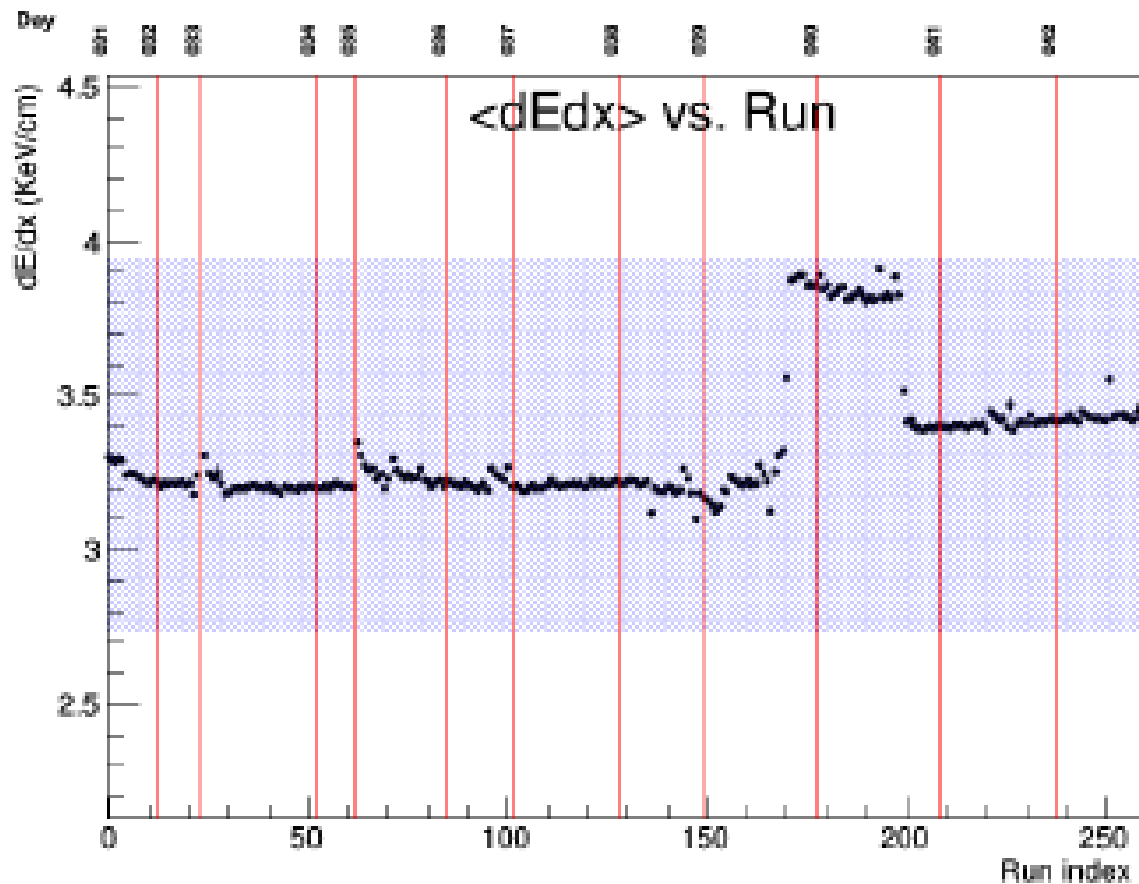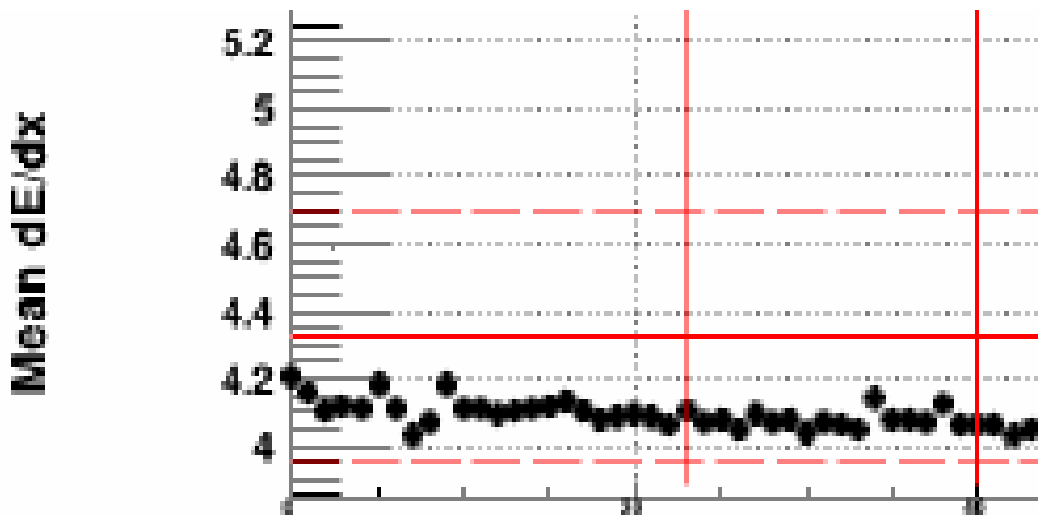**This should mean T0 should be good to 0.014 μs, and drift velocity accurate to 0.002 cm/μs**

histo_nHitsFit

histo_nHitsFit	
Entries	5.381803e+07
Mean	49.63
Std Dev	14.74

Good Tracks

Nhitsfit

dE/dx Calibration:

PID bands of 2 or 3 sigma are less forgiving

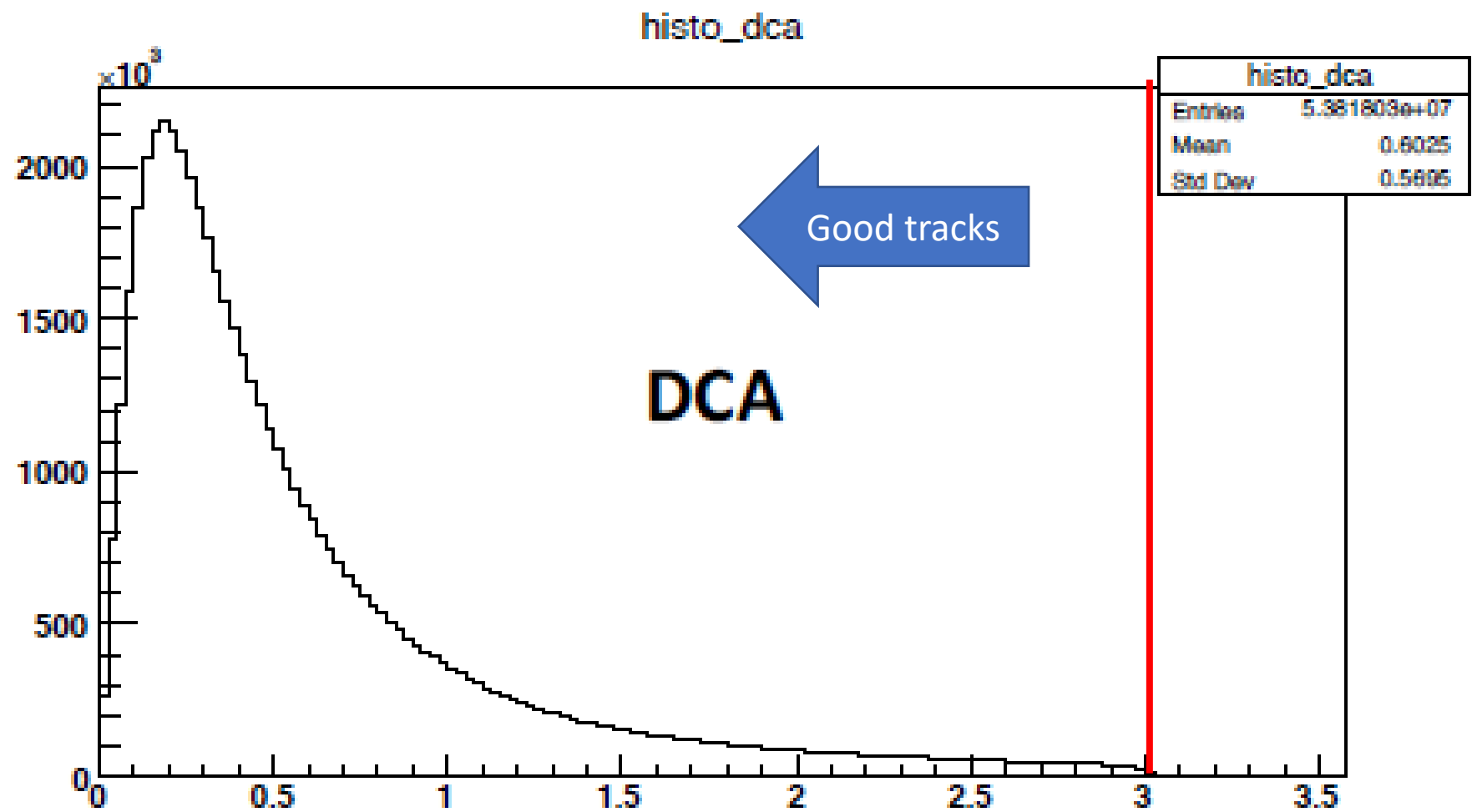**PWGs are setting their <dE/dx> good run cuts band at .4** to 6 keV/cm

Alignment and Space Charge Calibrations:

DCA cuts of 3 cm are very forgiving. The std dev. Of the DCA distribution is ~6 mm.

PWGs are setting there <DCA> good run cuts band at 500 to 800 microns.

Conclusions

- QA/QC for BES-II is being done at multiple levels, from run-by-run checks by the Shift Crew, to weekly QA Board reviews, and finally to reviews of the calibrated produced data.

- The final run-by-run QA will need to more carefully review which observables are adopted for all working groups

- Requirements of Calibrations: (Please consider to be a work in progress)
  - T0 should be good to 0.014 μs
  - Drift Velocity good to 0.002 cm/μs
  - dE/dx good to 0.5 keV/cm
  - Alignment and Space charge corrections should not affect the DCA more than 750 microns.